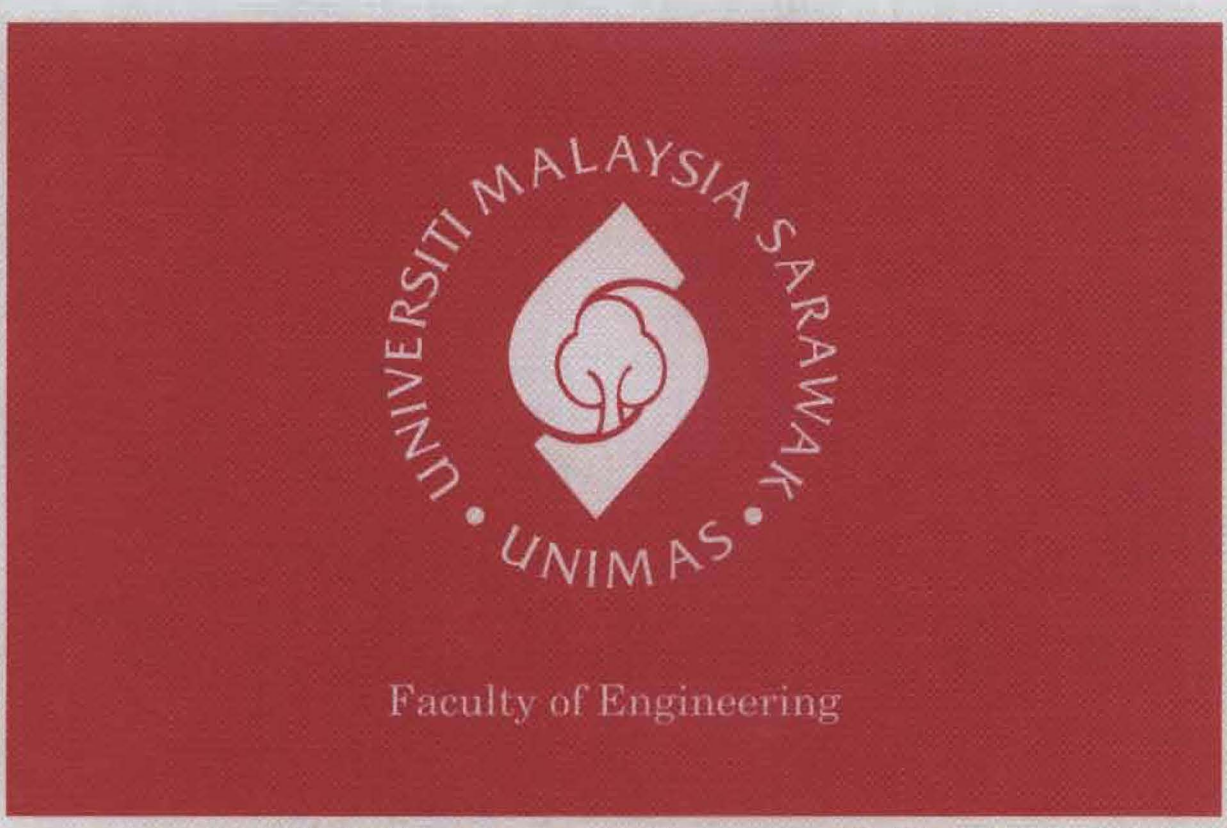

THE STUDY OF RADIATION EFFECTS OF MOBILE PHONES

Agnes Hii Wee Teen

Bachelor of Engineering with Honours
(Electronics and Telecommunications Engineering)
2009

UNIVERSITI MALAYSIA SARAWAK

R13a

BORANG PENGESAHAN STATUS TESIS

Judul: **THE STUDY OF RADIATION EFFECTS OF MOBILE PHONES**

SESI PENGAJIAN: 2008/2000

Saya **AGNES HII WEE TEEN**
(HURUF BESAR)

mengaku membenarkan tesis * ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sarawak.
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Membuat pendigitan untuk membangunkan Pangkalan Data Kandungan Tempatan.
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
5. ** Sila tandakan (✔) di kotak yang berkenaan

☐ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).

☐ TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan).

☑ TIDAK TERHAD

Disahkan oleh

(TANDATANGAN PENULIS) (TANDATANGAN PENYELIA)

Alamat tetap: PARCEL NO A2-1 UNIT 5
TABUAN STUTONG APARTMENT
93350 KUCHING , SARAWAK

KASUMAWATI BINTI LIAS
Nama Penyelia

Tarikh: 11/6/09 Tarikh: 11/6/09

CATATAN
* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda.
** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.

THE STUDY OF RADIATION EFFECTS OF MOBILE PHONES

AGNES HII WEE TEEN

This project report is submitted as a partial fulfillment of

the requirements for the degree of Bachelor of Engineering with Honors

(Electronics and Telecommunication Engineering)

Faculty of Engineering

UNIVERSITI MALAYSIA SARAWAK

2008/2009

This Final Year Project attached here:

Title : The Study of Radiation Effects of Mobile Phones

Student Name : Agnes Hii Wee Teen

Matric No : 13651

has been read and approved by:

Ms. Kasumawati Binti Lias

(Supervisor)

11/6/09

Date

Dedicated to my beloved family and friends

ACKNOWLEDGEMENT

This project has been made possible as a result of the co-operation and support rendered by several individuals. While it is impossible to list down all of them, I am very grateful for their assistance.

Firstly, I would like to thank my supervisor, Ms. Kasumawati Binti Lias. Her comments support, and guidance has helped me throughout the course our project. Without her cooperation and dedicated work in keeping the project on track, I would not be able to complete the project easily and on time.

Thankfulness would like to give to my friends and family who give full supports to me either morally or financially. They had helped me in sailing through the many hard days in lives and studies all these while.

Finally, I express my gratefulness to in the individuals who involved direct or indirectly during the progress of this project.

ABSTRAK

Dalam era modenisasi ini, komunikasi memainkan peranan yang penting untuk menyebarkan dan menyampaikan maklumat kepada orang ramai melalui pelbagai saluran. Komunikasi turut menyumbangkan kepada perhubungan atau perantaraan antara masyarakat. Menurut kajian, sejak kebelakangan ini, pengunaan alat komunikasi seperti telefon bimbit telah mendapat sambutan yang hangat ekoran daripada ledakan sains dan teknologi. Keadaan sedemikian telah menimbulkan isu kesihatan di kalangan masyarakat akibat daripada pengunaaan telefon bimbit secara berleluasa yang berkait rapat dengan pendedahan terhadap radio frekuensi. Oleh itu, projek ini bertujuan untuk menyelidik kesan pemancaran oleh telefon bimbit terhadap manusia. Sasaran utama projek ini adalah untuk mencari nilai "Specific Absorption Rate" (SAR) melalui simulasi "Finite-Difference Time-Domain" (FDTD). Projek ini menumpukan secara terperinci untuk SAR 1g dan 10g tisu otak. Dalam konteks ini, dua jenis telefon bimbit digunakan untuk kajian iaitu telefon bimbit dengan antena dalaman ataupun telefon bimbit dengan antena luaran. Simulasi ini merangkumi frekuensi 900MHz dan 1800MHz. Di samping itu, kuasa telefon bimbit yang digunakan untuk simulasi diselaraskan , iaitu 600mW. Dengan merujuk kepada hasil kajian, didapati bahawa nilai SAR bagi 1g dan 10g tisu otak tidak melebihi had yang ditetapkan oleh ICNIRP (International Comission on Non-Ionizing Radition Protection), iaitu $2W/Kg$. Oleh yang demikian, kesimpulannya, pengunaan telefon bimbit tidak memaparkan kesan terhadap kesihatan manusia. Walaubagaimanapun, telefon bimbit mampu meninggalkan

kesan sampingan dari segi biologi terhadap penggunanya seperti mual, sakit kepala dan penat. Secara keseluruhan, pemancaran daripada telefon bimbit tidak memberi kesan terhadap kesihatan manusia tetapi kajian lanjut perlu dilakukan untuk memperoleh bukti yang kukuh bagi menunjukkan kesan pemancaran daripada telefon bimbit terhadap kesihatan manusia.

ABSTRACT

Communication referred as an information transmission from one place to another place. It plays an important role especially in this modern generation. According to the research, the usage of mobile communication such as mobile phones had increased rapidly. With that, peoples concern about the health issues arise from the wide usage of mobile phones which are associated with the Radio Frequency (RF) exposure from the mobile phones. This project investigates the radiation effects of mobile phones towards human health. The main aim of this project is to determine the ***Specific Absorption Rate (SAR)*** values via ***Finite-Difference Time-Domain (FDTD)*** simulation in order to indicate the effects of mobile phones towards human health. This project concentrates on the SAR value computation of 1g and 10g of brain tissue. Throughout this project, two types of mobile phones either with internal or external antenna is taking into consideration. The frequencies 900MHz and 1800MHz are covered for simulation. In addition, the mobile phones input power is standardized as 600mW. According to the results, the SAR values obtained for 1g and 10g of brain tissue do not exceed the limit of threshold exposure, $2W/Kg$. Therefore it can be deduced that the mobile phones exhibit no adverse health effects towards human health. However, there are several temporary adverse health effects such as dizziness, headaches and fatigue. As a conclusion, the radiations of the mobile phones do not produce adverse health effects towards human health. Nevertheless, further investigations are required in order to provide concrete evidences on mobile phones radiation effects towards human health.

LIST OF TABLES

External Antenna

LIST OF FIGURES

ABBREVIATIONS

LIST OF NOTATIONS

2G	Second Generation Mobile Communication
3G	Third Generation Wireless Technology
4G	Fourth Generation Mobile Communication
ABC	Absorbing Boundary Condition
AMPS	Amplitude Modulation Pulse Synchronize
CDMA	Code Division Multiple Access
EM	Electromagnetic
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EMW	Electromagnetic Wave
FDTD	Finite Difference Time Domain
GSM	Global System for Mobile Communication
GUI	Graphic User Interface
IC	Integrated Circuit
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEGMP	International Expert Group on Mobile Phones
MCMC	Malaysian Communications and Multimedia Commission
MHLG	Ministry of Housing and Local Government
MMIC	Monolithic Microwave Integrated Circuit
MMS	Multimedia Messaging Service
MOH	Ministry of Health Malaysia
MOM	Method Of Moment
MRI	Magnetic Resonance Imaging
MSC	Mobile Switching Center
NIR	Non-Ionizing Radiation
NMT	Nordic Mobile Telephone
NNT	Nippon Telegraph and Telephone
PEC	Perfectly Electric Conductor
PMC	Perfectly Magnetic Conductor
PML	Perfectly Matched Layer
RF	Radio Frequency
RFIC	Radio Frequency Integrated circuit
SAR	Specific Absorption Rate

SMS	Short Message Service
TDMA	Time Division Multiple Access
UMTS	Universal Mobile Telecommunications system
UPML	Unsplit Perfectly Matched Layer
W-CDMA	Wide Band Code Division Multiple Access
WHO	World Health Organization

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Introduction

Mobile phone also known as wireless phone or cellular phone which is a short-range, portable electronic device used for voice or data communication over a network. First wireless phone was developed in year of 1915 [1]. However, the first commercial mobile phone service was launched in Japan by Nippon Telegraph and Telephone (NTT) in 1978. In addition to the standard voice function of a telephone, current mobile phones technologies are able to support many additional services such as messaging(SMS), email, packet switching for Internet access, Bluetooth, infrared and camera.

According to the research, by the year of 2007, the total number of mobile phone subscriptions in the world had reached 3.3 billion or equivalent to half of the human population [2]. This shows that mobile phones become most widely spread technology and commonly used electronic devices with the increasing number of users. The increasing number of mobile phones users had raised health issues among the public. There are numerous studies and researches have been carried out in order to find out the possibility of the adverse health effects of mobile phones towards human health.

In addition, international organization such as World Health Organization (WHO), International Commission on Non-Ionizing Radiation Protection (ICNIRP) and Independent Expert Group on Mobile Phone (IEGMP) had published the documentations on the effects of mobile phones radiation towards human health. However, continuous studies and researches are needed in order to provide the concrete results on the effects of mobile phones towards human health. Therefore, the main aim of this project is to do simulation on SAR (specific absorption rate) by using FDTD (Finite Difference Time-Domain).

1.2 Problem Statement

The usage of mobile phones had increased rapidly. This raised some issues related to human health associated with the exposure to radio frequency. There are numerous literature researches and studies have been carried out onto the adverse health effects of chronic exposure to electromagnetic radiation [3]. Based on these previous researches, there is still no unambiguous prove and evidence shows the possibility of adverse health effects of mobile phones towards human. Therefore, this project was carried out to measure the SAR (specific absorption rate) with the aim to obtain explicit result to show the probability and possibility of adverse health effects of mobile phones towards human health.

1.3 Project Objectives

The objectives of the project are:

I. **To investigate the radiation effects of mobile phones towards human health**

According to the literature research, there is still no clear evidence of adverse health effects of mobile phones towards human. However, the exposures to the radiation of mobile phones do have temporary adverse health effects on mobile phone users such as headaches, dizziness and fatigue.

II. **To measure Specific Absorption Rate (SAR) values via Finite-Difference Time-Domain (FDTD) simulation that indicates the effects of mobile phones towards human health**

The SAR values measurement emphasize on the 1g and 10g human brain tissue. The comparison of SAR values are made by using different types of mobile phones such as mobile phone with internal monopole antenna and mobile phone with external monopole antenna. The SAR values of mobile phones for different frequencies with an appropriate power level are also being compared.